Critical Notice of
Wandering Significance: An Essay on Conceptual Behavior
by Mark Wilson
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This monumental volume aims to redirect philosophical work on concepts towards explaining how we can successfully navigate the daunting complexity of the natural world. For Wilson, talk of concepts is primarily useful in the context of evaluating the activities of others and ourselves, as when we say "Archie has never fully grasped the concepts of the calculus, so of course he can't work the problems" (p. 2). This critical task is not best achieved using the theories of concepts that are the focus of many philosophers of language and mind. The reason for this is that most of these approaches are developed in the grip of what Wilson calls the "classical picture of concepts" (p. 4). This picture has many aspects, but the central feature which seems to most concern Wilson is the assumption that a concept is something that can be definitively grasped by an individual, often at a young age (p. 19). By contrast, Wilson argues that the evaluation of conceptual activities is a highly contextual affair which should be influenced by the success or failure of an agent in solving real world problems. It is the need to take account of the resistance offered by the natural world that forces concepts to develop in unanticipated ways: "an evolving natural language frequently displays a strong tendency to form into parochial pockets within which old vocabulary often assumes new, localized readings" (p. 37). Wilson's book could be summarized, then, as the attempt to develop a new picture of concepts that places these tendencies at the center. However, there is another rival picture which Wilson is at pains to avoid. This is the view developed by some "pre-pragmatist" writers who correctly criticize the classical picture, but who go on to misdiagnose the status of the "parochial pockets" that our concepts develop. Here the danger is that standards of conceptual evaluation will be thrown out completely so that our conceptual activities become unmoored from the restraints imposed by the real world. Recognizing the limitations

of such "a hazy sort of holism" (p. 178), Wilson concedes that "The trick, therefore, is to weaken the classical picture of content sufficiently to bring our conceptual expectations into alignment with what is humanly feasible, without utterly shutting the door on our capacities to improve our usage in rigor and clarity" (p. 34).

This balancing act leads Wilson on a long and intricate journey which seeks both to marshal sufficiently many examples of the sort of conceptual development he thinks is central to conceptual evaluation as well as to resist the temptations of the classical and holistic pictures. Roughly, the first five chapters aim to expose the limitations of the two pictures of concepts which Wilson opposes, while the five remaining chapters develop the alternative picture that Wilson favors.[1] As I will explain shortly, Wilson's discussion returns again and again to the lessons that applied mathematicians learned as they grappled with difficult practical tasks that combine our best science with advanced technological uses. In particular, Wilson takes as a prototype for conceptual development the surprising ways in which an attempt to understand the local behavior of a complex system can fail if it is prematurely applied at the global level. In this respect, Wilson's book has many affinities with Batterman's work on asymptotic representation and explanation ((Batterman 2002), (Batterman 2009)).

After an overview of the book in chapter 1, chapter 2 delves deeper into the "ur-philosophical" (p. 46) motivations for the classical picture in both its objective and subjective manifestations. The example which structures Wilson's discussion in this chapter is an unusual one. Starting from the observation that Mozart's Symphony in G Minor bears the attribute of expressing sadness musically, Wilson presses further to see what exactly this comes to in the context of sound recording. Some might be tempted to follow an unnamed philosopher who criticized Darwin for his lack of aesthetic sense (p. 51): "The **expressing sadness musically** aspects of Mozart seem so *palpably present* to our critic that he can only imagine that inattentive laziness or some allied form of intellectual distraction can explain why the old man seems unable to recognize their presence in the Symphony in G Minor and elsewhere" (p. 59).[2] This conception of musical attributes is deeply flawed, though, for it underestimates the wide range of "tools and capacities" (p.

[1] See p. xvi for a summary of the chapters and p. xix for a suggestion about how to skip some sections of the book based on one's interests.

[2] Wilson uses boldface for words for attributes, italics for emphasis, underlining for the names of books or works of music, and quotation marks for linguistic predicates.

60) that must be exercised in the appreciation of the emotional character of a piece of music. Attributes of this sort, then, need to be distinguished from other attributes like **being a dog** where "we can lay down a wide variety of tasks in a manner that does not require that a subject approach their completion in any particular fashion" (p. 60). The classical picture is appropriate for these sorts of attributes, at least "to first approximation" (p. 41). But if we extend the classical picture to the attribute **expressing sadness musically**, then we are bound for trouble.

The main source of trouble is the uncooperative character of the phenomenon in question. When it comes to sound, an example of this is the appearance of "combination tones" as when "a middle C note played simultaneously with a higher G can induce spurious vibrations in the cochlea that will be heard as the low C note marked in the bass clef, although no note in that vibratory range has actually been sounded by the instrument in question" (pp. 63-64). This surprising facet of sound and its relevance to music appreciation undermines the objective version of the classical approach to concepts because it is no longer an option to assume that such attributes are simply out there in the natural world waiting to be perceived. Instead, one must recognize that context, capacity or "point-of-view" (p. 84) is relevant to conceptual evaluation. Advocates of the classical picture are tempted to respond that these problems with the objective approach show that the genuine location of the attributes in question is instead subjective entities such as our immediate experiences: "the true support of the predicate "expresses sadness musically" lies situated in *inner experience* ... [and] the proper basis of musical classification reflects the directly instructive character of sensory presentation" (p. 71). The classical picture remains intact, though, because even though the bearer of the attribute has shifted its location, the relationship between the concept and attribute is still thought of on the model of the exercise of a simple capacity, e.g. being "directly acquainted" (p. 70).

While this oscillation between objective and subjective bearers is familiar from other debates such as those concerning color, Wilson goes on to add a third strain of the classical picture which has a greater air of sophistication and novelty. This is what he calls the "amphibolic" (p. 78) response according to which objectivism and subjectivism are both wrong because "Our apparent "inner and outer worlds" should be viewed as comprised of essentially the same stuff, merely regarded from different perspectives" (p. 77). Kant and post-Kantians like Bosanquet are noted here, as are contemporary "anti-correlationists" (p. 79) such as Gary Ebbs who argue (in

Wilson's words) that "attributes should not be conceived as existing independently of our structures of conceptualization" (p. 79). Wilson objects that when carried through consistently this version of the classical picture winds up locating the fixed semantic contents of our concepts in the entire web of our commitments. Anti-correlationism of this sort, then, "is usually driven to contend that we have been supplied with two distinct "ways of worldmaking" that describe reality in intrinsically different terms" (p. 81). At this point, though, the prospect of contextual and well-motivated conceptual evaluation and improvement has been abandoned and any form of scientific realism is 'unmasked' as naive.

A thorough investigation of the classical picture of concepts is pursued in chapter 3 where Russell's *Problems of Philosophy* (Russell 1912) is taken as its most persuasive exposition. This may come as a surprise to many readers as Russell's views on acquaintance, sense-data and the description theory of names seem completely outdated to most philosophers working today. But what Wilson emphasizes is Russell's view that universals can function both in a "report upon a specific individual's frame of mind" as well as to "register the condition of physical surroundings" (p. 90).[3] Our direct acquaintance with a universal allows an individual to completely master the concept in question, for Russell, precisely because this universal is a part of the facts that make up the mind-independent natural world. Wilson also points out the resulting picture of linguistic understanding and communication where I associate predicates with concepts and hope that you have made the same sorts of associations based on your own acquaintances (p. 140). Finally, the subject-matter of philosophical activity falls into place on this classical picture: "Philosophers thus serve as custodians of the conceptual realm" (p. 143) who should aim to clarify and refine our thinking through reflection on the concepts grasped in ordinary thinking. This picture is arguably shared by contemporary philosophers like Peacocke who would otherwise reject many of Russell's views.[4]

The link between the classical picture surveyed in chapter 3 and the location problem for musical attributes discussed in chapter 2 is hard to

[3]See also pp. 139-146 where the central commitments of the classical picture are summarized.

[4]This is especially clear for *Study of Concepts* (Peacocke 1992) which Wilson notes at p. 479. Wilson goes on to wonder how Peacocke might extend this approach to mathematical concepts without noting Peacocke's own attempts to do this in later work (Peacocke 1998) and (Peacocke 2004). For a critical reaction to this later work see (Tennant 2005).

appreciate without considering an example in greater detail and Wilson's proposed alternative. Although Wilson's diagnosis of the combination tones is satisfying and to the point, the reader must wait until chapter 7 for it to be revealed. There Wilson considers what sort of "musical notation" should be used to record a piece in which these tones arise and potentially contribute to its attributes. The sensible response to this question is that it depends upon the purposes of the recording. While a performer will point out that the extra tone should not be recorded as it does not correspond to a note that the performer must play, the composer (or sound engineer) will emphasize the contribution of the note to the piece. So, "the parting of the classificatory ways arises because the associated purposes of reproduction and planning here diverge . . . As such, both responses seem natural in their context and scarcely subject to cavil" (p. 455). It is the classical picture described in chapter 3, then, that is responsible for the misdiagnosis of the situation revealed in the debate between the subjectivist and objectivist in chapter 2. The classicist requires an "invariant content" across context and so struggles to find a proper bearer for the attribute. Wilson's response is that diverging purposes and unknown aspects of the phenomenon frustrate this quest for constancy and prompt philosophical confusion.

While Wilson does not delve further into the scientific aspects of acoustics and sound recording here, he does say more about color. Already in chapter 3 Wilson had argued that on the classical view concepts like being red will typically become "overloaded" (p. 104). The entities which become overburdened are the associated "descriptive predicates that have become subject to a larger degree of heightened demand on their performance" (p. 100), typically in practical tasks of engineering and design. With redness, for example, the classicist like Russell will insist that our grasp of this concept involves a basic form of direct acquaintance. As with Russell's views in *Problems*, this leads to a subjective location for the bearer of color attributes. To be sure, Russell allows a kind of objective correlate for color predicates which is picked out structurally. This network of relationships is then said to be responsible for our range of application of color predicates according to complicated "inferential directivities" (p. 106). Wilson also here notes Helen Keller's response to this sort of classical picture. She emphasized that the ability to follow these "inferential directivities" or rules is more central to color talk than any basic acquaintance. However, for reasons that will shortly become clear Wilson worries that this sort of purely structural approach to color concepts is no better than Russell's proposal.

The way out of this impasse is again given much later in the book and can serve as a central example of Wilson's positive proposal for how to make sense of conceptual evaluation. As Wilson describes it, scientific investigation of ordinary color perception has revealed that it is based on a complex consideration of how an object looks as we engage with it over time: "usually we subject our specimens to sundry patterns of manipulation, generally parochial to the stuff in question. With a metallic vase, say, we typically rotate the object to study its spectral appearance at different angles (or, to employ the technical term, survey its goniochromatic aspects)" (p. 461). This process is overlooked by the classicist who assumes that our color judgments involve some kind of tacit comparison of the vase or how the vase looks with an array of remembered color samples. Really, though, Wilson proposes that our ordinary color evaluations involve placing the object in what he calls a "color class space" which takes account of the differences in "goniochromatic aspects". This accounts for our fine-grained color distinctions. Still, what happens if a practical task like the manufacture of "automobile enamels" (p. 463) or weaving demands greater accuracy and regularity (p. 456)? Very quickly the scientists involved will notice features like the combination tones in music. As Wilson relates, a white piece of tapestry can be made to look pink based on its surroundings, so "an isolating screen of gray paper" can be used to find out if the material is really white. At the same time, if we examine some brown cloth through "a darkened tube", it will come to look orange. The classical picture responds by retreating to the subjective realm, as with Russell, or to purely inferential accounts, as with Keller.

Wilson responds that our color concepts ramify into a network of related "patches" where univocal color evaluations can be made based on the purposes at hand despite the overall "multi-valuedness" (p. 456) of our color concepts. On this "facade" approach, our ordinary color classifications are conceived of as assigning an object to a position in a more-or-less stable region of color class space. We can then develop another patch called the "color tag space" by considering paint chips placed in a light box. Finally, we can establish stable links between some regions of the color tag space and the objects embedded in the color class space. Wilson claims that this will work for some objects like walls that are painted uniformly, but will fail for other objects like the metallic vase. So, "the packets of information conveyed in a color class predication are both richer and of a different order than those supplied in localized behavioral comparisons (of a light box ilk)" (p. 464). This means we cannot cover the whole of our ordinary color class space us-

ing a regimented space like the color tag space. Still, "both subclasses of everyday color classification embody a good deal of indubitably objective information about their target objects and behaviors, but of quite different types depending upon the patch locally covered" (p. 465).

A review of Wilson's discussion of color shows how central mathematical analogies are to his positive view of how conceptual evaluation works. For example, the multi-valuedness of concepts is explained by reference to the behavior of functions like the positive square root or natural logarithm as they are extended from the real numbers to the complex numbers. Such an extension is possible, but only using tools whose effectiveness is limited to local "branches" of these functions. Square root, for example, is associated with two branch functions which are single-valued in their respective domains, while the natural logarithm is handled using infinitely many such branch functions.[5] As Wilson puts it, "there's no way to "uniformize" its $[\sqrt{z}]$ behavior to a single-valued covering of the complex plane that doesn't include artificial rips and tears. Hidden within the personality of the manner in which we calculate roots over the real numbers lies a torsion that manifests itself as an inherent multi-valuedness when those rules are prolonged across the complex domain, even if we heartily wish that $\sqrt{z}$ wouldn't behave like that" (p. 317). Analogies derived from the classical picture are of little use here. For example, it is not helpful to say that the concept of the square root function was ambiguous all along and that the extension to the complex plane revealed this, or that the univocal concept happens to be multiply realized in the complex plane. Both proposals discount the natural ways in which the branch functions arise out of the function on the real numbers and what this tells us about the mathematical domains in question. This feature serves as a "prototype" (p. 317) for Wilson's proposal about patches for his color case and other cases which he discusses. It is not possible to prolong our color tag space usage over to the color class space patch. But this does not make the associations which we can establish arbitrary or reveal some hidden ambiguity or multiple realizability in our color concepts. Instead, we come to find out more about color and its relationship to our practices of color classification.

A second mathematical analogy concerns the notion of an atlas of charts which is used to represent features of a manifold. Indeed, this may not be a distinct analogy as the sort of multi-valuedness noted above can be

[5]See, e.g., §26 of (Brown and Churchill 1996).

understood using an unusual sort of manifold called a Riemann surface, as Wilson notes several times (p. 317).[6] To take a well-known case, we can project the three-dimensional surface of the Earth and its features onto a two-dimensional map or chart in various ways. Because of the kind of mismatch in the topology of the two surfaces, some distortion is inevitable. For different purposes, then, a different chart or sequence of charts should be used. For example, as Wilson explains, the Hammer projection of the sphere does a good job of preserving the relative sizes of the countries represented. But the demands of navigation support a different projection, i.e. the Mercator projection, as "the compass and sextant routes that a sailing vessel might reasonably follow appear on such maps as straight lines" (p. 289). It is futile to try to devise a 'perfect' projection which will serve all purposes equally well, although some strategies of projection can be more widely used than others. What is needed, then, is an atlas with many charts, along with a good preface which lays out the proper basis for using this or that chart: "Most good atlases also contain a preface that delineates the projections that underlie the component charts, as well as explaining the proper strategies of map employment" (p. 292). This explanation supplies the rationale for linking the different charts together. Furthermore, "the overlapping and fibered set of maps included in an atlas represent the inspirational prototype for my facades, for an atlas represents an evocative way to visualize the ways in which various blocks of usage need to fit together in order to cover a subject matter effectively" (p. 292). So, returning to our color case, the relatively simple color tag space cannot be used to cover the color class space, just as a given two-dimensional chart cannot represent accurately all the features of the three-dimensional Earth. Nevertheless, a well-chosen family of patches, as with an atlas of charts, can do justice to the complexities of the color class space.

Sometimes these mathematical prototypes are used to argue for Wilson's conclusions regarding ordinary concepts. After noting Hardin's claim that color science shows that "there are, in the nature of the case, no such [color] ascriptions that are both precise and correct" (p. 462), Wilson argues that "this is not the right way to look at these matters" (p. 462). The problems motivating Hardin's conclusion are "equipollent to the extendability of a local coordinate system" and "We don't conclude that the earth doesn't exist simply because we can't prolong coordinates over its entire surface in

[6]See, again e.g., §77 of (Brown and Churchill 1996) for a basic introduction.

the simple manner we anticipate!" (p. 462). In a similar fashion, we should tackle the problems with color classification using the facade of patches that Wilson articulates and grant its limited ability to capture objective features of many of the situations that interest us.

Mathematics enters into other examples that Wilson discusses in a more direct way and this suggests that his mathematical "prototypes" are more than just an inspiration for his positive views of how conceptual evaluation works. The link is summarized in chapter 4 with the somewhat opaque pronouncement that "distributed normativity enters the story of language mainly as the driving force within the nucleation of fresh patches of usage at certain points in a predicate's career" (p. 176). That is, in addition to the pressures applied from real-world phenomenon like sound and color that have been discussed so far, there are also more internal sources for the formation of new patches for our predicates. These come out when Wilson emphasizes the need for "variable reduction". Any attempt to completely describe a complex physical system is bound to fail as the resulting description will be so complicated that it is useless to us for all practical and theoretical purposes. Instead, a highly simplified description is needed which will reduce the complexity by selectively emphasizing certain features of the situation over others. To fit with our representational purposes, though, this simplification must meet up with some kind of technique for extracting useful information about the system from the reduced description. It is these techniques that Wilson sees as the source of "distributed normativity" which allows the scientist to proceed. And in nearly all of the cases that Wilson discusses, the techniques in question are highly mathematical. But a particular mathematical tool does its work because it operates within the highly simplified context of that specific patch and "Typically, quite different mathematical tools supply the inferential engines that drive the reasoning within each patch" (p. 191). Furthermore, the way in which the description is simplified can be tied to the mathematics itself.

As a central example reflecting "the manner in which successful variable reduction typically works" (p. 190) Wilson draws on the Riemann-Hugoniot treatment of shock waves. The representation of a shock wave occurs when certain partial differential equations which are used to represent the compression of a gas develop regions of infinite density. However, despite this clearly unrealistic aspect of the representation, other parts of the representation can be used to find out how the gas behaves over time in the region around the shocks. In such cases "a good recipe for achieving descriptive success *papers*

over the physical events most responsible for the phenomena we witness!" (p. 190). A successful variable reduction, then, often deploys mathematical techniques which preclude any direct means of uniting the different patches into a single, axiomatic framework. Wilson uses these aspects of classical mechanics to argue that "its descriptive policies cannot be regularized enough to submit to proper axiomatic organization" (p. 195).[7]

On Wilson's picture, then, highly localized patches in which our concepts can be successfully deployed tend to develop under the twin pressures of real-world complexity and the features of the mathematics that we can fashion to cope with this complexity. Both pressures come together in Wilson's extended discussion of the concept of hardness (pp. 335-355). Wilson notes Descartes and Reid's disagreement over the nature of hardness. While Descartes claimed it was a dispositional property that gave rise to a particular kind of sensation, Reid objected that no such sensation could be found. Instead, hardness is "perfectly understood" as the "cohesion of parts with more or less force" (quoted at p. 336). These are of course the same subjective and objective manifestations of the classical picture of concepts that Wilson has observed for sound and color concepts. Again, as with these concepts, the original deployment of the predicate "hardness" conceals a hidden complexity which appears only when practical demands force a new level of precision. This exposes the multi-valuedness of the predicate via the development of many different ways of determining hardness. These include the well-known Mohs-Bierbaum approach in terms of scratching, but also squeezing, indentation and abrasion. In an elaborate picture (p. 338) Wilson presents these different patches along with the associated materials to which they are commonly applied: "The exact nature of these refinements in technique typically depend on not only the *type* of material under consideration but the *circumstances* in which an evaluation of "hardness" is likely to be required" (pp. 338-339). In particular, for plastics a test involving squeezing using an instrument known as a durometer is preferred whereas for many metals a test involving punching using a Brinell indicator is often used (p. 339). No sensation or underlying physical property of "cohesion" can be used to stich together these different patches. Instead, Wilson returns to the picture supplied by the extension of real-valued functions to the complex plane and concludes that we have only a "set of evaluative patches linked together in a Riemann surface-like way through instrumentally inspired continuations"

[7] A recent application of this conclusion to debates about determinism is (Wilson 2009).

(p. 350).[8]

This is not the end of the story, though, as the predicate "hardness" is enmeshed in a network of complicated connections to other predicates used to understand materials such as "rigid", "solid" and "force". All of these links can be exploited through the development of classical mechanics, but they interact with each other and with their associated mathematical refinements in unpredictable ways. In some of the most interesting parts of the book, Wilson argues that nineteenth century debates about the foundations of classical mechanics often represented different "semantic hunches" (p. 367) about how it might be possible to clarify the connections between these concepts or even arrive at an ultimately rigorous axiomatic presentation.[9] The writings of Duhem, Kelvin, Hertz, Pearson and others are profitably reconstructed from this perspective. Crucially, though, while Wilson is broadly sympathetic to the problems that these writers ran into with their somewhat speculative leaps, he insists that more recent developments in mathematics and science have given us the tools to better appreciate the situation. These include a deeper mathematical understanding of series representations of quantities (pp. 242-258) and the surprising character of quantum mechanics. Indeed, it is the engineer, mathematician and scientist Oliver Heaviside who emerges as a hero of Wilson's discussion as it is Heaviside's resolute focus on practical tasks and slogan that "Logic is eternal, so it can wait" (at p. 28) which proved ultimately appropriate.[10]

From this perspective, largely developed in the first half of the book, Wilson goes on to explain what strategies scientists and applied mathematicians have developed to cope with the facade-like structure of conceptual evaluation. As he summarizes things towards the end of chapter 5,

> virtually every term of macroscopic evaluation has its own complex story to tell and, without much subtler clarity of purpose, it is absurd to embark upon a project of trying to decide whether **being a gear wheel** is "required in our ontology" or not. Each of our listed predicates performs valuable linguistic work most of the time, but on occasion each also misleads, simply because it functions in more complex ways than we appreciate. In the sequel, I will not supply any grand "big picture" that explains

[8] See also pp. 377-381 for an overview of facades.

[9] See also p. 284.

[10] See especially pp. 518-529.

> how all predicates behave – my story would be inconsistent if I believed that possible –, but I can provide simple models that demonstrate how a range of typical *ur*-philosophical misapprehensions can arise from the unexpected behaviors of particular predicates (p. 278).

These models allow the "semantic detoxification" (p. 545) which is required when inappropriate pictures are foisted on our predicates and the further development of more modest "correlational pictures" (pp. 515-518) which help us to understand how our practices are successful in their limited domains. Just as there is no prospect of uniting the patches of "hardness" into a rigid axiomatic structure, so too, for Wilson, there is no hope of a "big picture" theory of concepts and reference. This is because the predicates "is a concept" and "refers to" are just as prone to manifest a facade-like structure of incompatible patches of successful usage as are the other predicates of macroscopic evaluation. This does not lead to any Quinean rejection of reference or intension, but, as with our more modest conception of hardness, an objective yet highly contextual picture of how talk of concepts and reference can usefully function.

Wilson presents, then, not only a new way to think about concepts but a new model for how philosophy should be done and how it should situate itself with respect to the sciences. For once we accept that all these concepts at least have the potential to hide a ramified network of patches there is no longer much point in considering a priori intuitions of correct usage or other sorts of "armchair" tools of conceptual analysis. Instead, we must go out and digest a whole host of mathematics, science, engineering and even, it seems, manufacturing techniques. It is only by being continually immersed in the particulars of the strange behavior of this or that predicate that we can hope to appreciate our best representations of the world and what they teach us about it.

What I have said so far hardly does justice to either the range of examples that Wilson discusses or the wonderful tone of amusement and sheer intellectual enthusiasm which permeates the book. For anybody interested in the ways in which mathematics interacts with the rest of our conceptual tools for coping with the world's complexities, Wilson's book will be a source of delight and inspiration. That said, Wilson uses his book to argue for a very significant change in the way we approach concepts, and it must be asked if his discussions are up to this task. I believe that he has clearly put the

burden of proof on contemporary advocates of the classical approach to concepts to show what they think of the main cases that Wilson discusses. In the brief space I have left I would like to raise three concerns which suggest some broad lines of response to Wilson's proposals. First, does Wilson present us with an adequate account of mathematical concepts so that we can make sense of their peculiar interactions with our physical concepts? Second, how might we extend Wilson's discussion to cases beyond ordinary macroscopic concepts or, if we cannot see how to make this extension, what implications does that have for Wilson's conclusions? Finally, in its core area of focus, namely the concepts of macroscopic evaluation, what picture of the world and our scientific knowledge does Wilson's discussion suggest?

A direct way to press Wilson on his conception of mathematics is to note that nobody has really articulated a view of mathematics and its developments that avoids the extremes of the classical approach and hazy holism that Wilson is so eager to avoid for physical concepts. But much of Wilson's discussion seems premised on the viability of such an alternative for mathematics. This suggests that the role of analytic continuations as a prototype for patches and facades opens up a weak point. It seems clear that many advocates of the classical picture will adopt a philosophy of mathematics that undermines Wilson's arguments. Two strategies dominate contemporary philosophy of mathematics. On the one hand, the most influential form of platonism posits a determinate realm of sets which we aim to correctly describe in our best mathematical theories. If we add Gödel's apparent assumption of a direct intuitive access to some of the features of sets, we are not far from the central theses of the classical picture of concepts. On the other hand, if we depart from direct mathematical intuition in favor of a Quinean empirical justification for mathematics based on its role in science as a whole, then we are forced to adopt some sort of hazy holism for mathematics. Our mathematical concepts are motivated by their place in our overall web of belief and thus float free from any connection to their platonic subject matter. Other newer views of mathematics such as fictionalism make this holism even more extreme as they assign complete freedom to mathematicians to posit any domain they wish and pursue the study of its features based on what is "true in the story" that they have devised.

None of these approaches seems to have the resources to deal with Wilson's core case of the analytic continuation of real-valued functions into the complex plane. A traditional platonist seems forced to appeal to some kind of new intuition which led mathematicians to proceed in this way while Quinean

empiricists can draw only on an otherwise unspecified need for the mathematician to 'round out' their domain of study. Fictionalists are in an even worse position as they must posit new rounds of story-telling at various stages in the history of mathematics. All of this suggests that until this sort of development of mathematics is more clearly grounded, it is hard to see how Wilson can use it to motivate a new picture of our ordinary physical concepts. What is especially unfortunate here is that Wilson is one of the few people who have explored these sorts of issues and their implications for the philosophy of mathematics. In his article "Frege: The Royal Road from Geometry" he surveys the ways in which projective geometry developed in the nineteenth century. In that paper he notes the pioneering efforts of Kenneth Manders' "Domain Extension and the Philosophy of Mathematics" (Manders 1989), but ultimately concludes that "we scarcely understand the character of mathematical concepts – how it is that they can "grow and thrive" over time" (Wilson 1992, p. 176).[11] Given this concession, it is not clear that we can just trust Wilson's claims that analytic continuations should be taken at face-value and used to understand how physical concepts develop over time (pp. 312-319). And in the absence of Wilson's understanding of how analytic continuations work, the classicist is sure to respond by an appeal to ambiguity or multiple realizability.[12] I am not arguing that this response correctly reconstructs the development of mathematics, but only that in the context of an argument against the classical picture, it is not legitimate to presuppose an anti-classical account of mathematics which has yet to be articulated.

It remains possible that Wilson does not think of his book as an *argument* against the classical picture. He sometimes seems pessimistic that any discussion of the details of some particular case will dislodge the hold of this picture. This takes us to the more Wittgensteinian aspects of Wilson's book. As the above quotation indicates, Wilson is as interested in diagnosing why the classical picture has taken hold as he is in developing an alternative approach. In fact, his focus on leading his readers away from the classical picture may have influenced him to make the book as accessible as possible, despite its recurring appeal to advanced mathematics, engineering and science. As I have just argued, the pressure that mathematical aspects of concepts brings to bear on the development of our physical concepts is

[11] More recent work on this topic has been pursued by Jamie Tappenden. See, e.g., his (Tappenden 2008).

[12] This is more or less implied by Field's proposals concerning partial denotation. See (Field 2001), esp. part 2.

hard to understand until we have a better presentation of Wilson's views on mathematical concepts. But it appears that Wilson thought that this sort of discussion would make a long book even longer and might place too many demands on the mainstream philosophy audience which he is trying to engage. Still, I am not sure how convincing Wilson's arguments will be for a reader who is unable or unwilling to follow a more sophisticated mathematical and scientific presentation of the cases Wilson discusses. In my own case, at least, it was only upon learning (or in some cases relearning) the details of a particular case that Wilson's position became clearer and his arguments more persuasive. From the outside, as it were, the claim that $e^{\pi i} + 1 = 0$ or a description of the successful representation of shock waves will seem to be strange oddities which are unrelated to ordinary conceptual evaluation. This problem says more about the sad state of contemporary philosophy than the gaps in Wilson's presentation, but it makes it clear that the barriers to convincing the steadfast advocate of the classical picture are substantial.

In addition to the pressures from mathematics, I have also emphasized the ways in which Wilson's patches develop in response to unanticipated real-world complexity. Naturally, then, the classicist will wonder what Wilson's alternative picture becomes when this input is absent or at least substantially lessened. It is far from clear how Wilson's approach to concepts can be extended to these domains. In biology and economics, for example, mathematics is applied in various ways and the real world seems just as complex. But it is not clear that things work out in the same way as with physics. In particular, the need for variable reduction as Wilson describes it seems to be handled quite differently. In physics we can obtain a complicated mathematical representation of a messy physical system and variable reduction is used to obtain a workable if highly simplified representation. In biology and economics, though, the starting point is often just the highly idealized "reduced" description. There is then little basis upon which to compare one representation to another and the ways in which mathematics drive the representations seem harder to understand.[13] The point extends further to domains like psychology, ethics, political science, sociology and aesthetics where mathematics is less important. Here our concepts risk being disengaged from any pressures from the complexity of their subject matter as it is not even clear what the subject matter is or how it might impact our

[13]This difference between biology and physics is one way to make sense of the model-based science noted by (Godfrey-Smith 2006).

practical activities. Perhaps in these domains the attractions of the classical picture, or its evil twin holism, can carry the day.

It is of course unfair to complain that Wilson has not discussed concepts of every sort, and as we have seen he explicitly rules out the prospects of finding some common way in which concepts work in all domains. Still, the pictures of concepts which Wilson attacks have been used to cover these domains as well and it is not clear how problems in one domain will affect others. My impression is that Wilson thinks that the classical picture grew out of problems with concepts of macroscopic evaluation and then spread to infect other domains such as the concepts of psychology and music appreciation. A resolute focus on his physical concepts, then, makes a lot of sense and even if his facades fail to appear in other domains in the same way or under the same pressure, his argumentative strategy can be defended. Even so, it remains unclear what implications Wilson's discussion is supposed to have for other debates about concepts. Peacocke and others, for example, are quite eager to make sense of our access to our own mental states through introspection and use an account of concepts to do this (Peacocke 1992, ch. 6). Dislodging the classical picture for physical concepts may not displace its hold over such "first-person" concepts.

Finally, let's consider where Wilson's positive view of the core kind of concept which he discusses leaves us. A sympathetic reader of Wilson's book can finish it and still be fairly bewildered about its implications for debates about the proper interpretation of science and our scientific knowledge. It is clear that Wilson would reject a traditional no-miracles argument for scientific realism. This is because the general rule of inference to the best explanation is far too indiscriminate when applied to Wilson's facades (p. 279). Strictly speaking, there are no theories as usually conceived there for the aspiring scientific realist to assent to based on some philosophical argument, but only the loosely connected patches of successful predicate-attribute pairing. This strategy for rejecting traditional arguments for scientific realism may then bring to mind Cartwright's anti-fundamentalism and her positive proposal for a "dappled world" which our laboratory practices only latch on to in this or that limited respect (Cartwright 1999). It appears, though, that Wilson would also reject Cartwright's metaphysics as a misdiagnosis of the failures of the classical picture. He complains that "Cartwright completely overlooks the labors of the large army of applied mathematicians who have unraveled the concrete rationales behind many of the techniques that puzzle her, many of which represent some variation upon asymptotic approximation" (p.

201).[14] Similar worries surely extend to more recent attempts to incorporate the messy character of scientific practice into our interpretation of scientific knowledge such as Giere's "perspectivism" (Giere 2006).

My suggestion is that Wilson aims to defend what could be called a "patient" and limited form of scientific realism. The core assumption of this approach is that "successful instrumentalities, whether they be of a mechanical or a symbolic nature, always work for *reasons*, even if we often cannot correctly diagnose the nature of these operations until long after we have learned to work profitably with the instruments themselves" (p. 220). At any stage of scientific development our practical successes assure us that we are latching onto objective features of the world. This is then a large step towards the scientific realist who justifies our knowledge of unobservable features of the world by arguing that the truth of our best science is the best explanation of our success with the observable. Wilson believes that our best science is very good and that there is every reason to think we will get better at navigating the world. Still, he rejects the straightforward inference to the best explanation that propels the scientific realist to the conclusion that electrons exist. Instead, Wilson points out that we may not understand the basis for our practical success until "long after" we have achieved the success. At any given stage of scientific development, then, we can be sure that we are engaging with an objective reality, but we cannot be confident that we have the description of this reality right. Indeed, the more we see how mathematical concepts and physical concepts interact with the world and each other, the more we have a reason to hesitate in the face of the optimism of the traditional scientific realist. Wilson's patient realism, by contrast, urges us to wait and see how a given facade can be improved and clarified by later developments. There is no general test that can assure us that we are getting things right. This sort of limited optimism is focused on the specifics of this or that case and is reluctant to extrapolate any further. While it may not satisfy the craving for generality which Wilson correctly ascribes to many philosophers, Wilson's patient realism may simply be the best we can hope for.[15]

[14] See also (Wilson 2000).

[15] I am grateful to the editor of this journal and Mark Wilson for generous comments on an earlier version of this critical notice.

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